North East Linguistics Society

Volume 28 *Proceedings of the North East Linguistic Society 28 -- Volume One: Papers from the Main Sessions*

Article 19

1998

Abstract Output: An Optimality-Theoretic Analysis of Children's Omissions from Prosodically Complex Structures

Andrea Massar
University of Arizona

LouAnn Gerken
University of Arizona

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Andrea Massar & LouAnn Gerken

University of Arizona

Introduction

It is well known that young children omit unstressed syllables from their speech more frequently than syllables with stress. These omissions include unstressed syllables that are grammatical words, such as "the," as well as other syllables that are parts of lexical words, such as the first syllable of "giraffe." Previous accounts have treated children's omissions as a consequence of unmarked or simplified representations of prosodic structure (see for example Barlow, 1997; Demuth 1997; Gnanadesikan 1996; but see Ohala 1996). By contrast, we construct an optimality-theoretic model in which a series of variant forms produced by two-year olds have in common a single, adult-like prosodic structure.

We consider two sorts of analyses. They are virtually alike in the segmental omissions they predict for these data, but they differ in the form of the prosodic structures they include in the output. The first approach relies on a type of domain-specific input-output correspondence constraint (Contiguity) to avoid the deletion of material in the middle of prosodic constituents; the other approach accomplishes this with the use of zero-syllables in the output as placeholders for omitted segmental material. We suggest that a zero-syllable anaylsis may be preferable, because it allows us a straightforward and unified account of phonological and phonetic data.

We begin by showing you a subset of the data reported in Gerken (1996), along with her conclusions about the prosodic structures of the child output forms. Our analyses follow, in the next two sections. In the first analysis section, we present the constraints that are relevant to the right edges of prosodic words. In the second section, we deal with the more complex case of the left edge of prosodic words. The left edge is where, in fact, our two proposed analyses most clearly differ. We demonstrate how each analysis handles several child variants. Finally, we summarize the two analyses and discuss ways in which the zero syllables analysis may define a more interesting research program.

Pius N. Tamanji and Kiyomi Kusumoto (eds.). NELS 28, 253-266

The Data

The data are drawn from an experimental study reported in Gerken (1996). Previous researchers have noted that children are more likely to omit unstressed syllables that are unfooted than footed unstressed syllables (for example, see Wijnen, Krikhaar, & Den Os 1994; Gerken 1994b). Gerken uses this finding to measure whether or not children represent larger prosodic constituents described in theories of prosodic phonology (Selkirk 1978, 1986; Nespor & Vogel 1986; Beckman & Pierrehumbert 1986; Pierrehumbert & Beckman 1988; Hayes 1989).

The constituent that concerns us here is the prosodic word. Briefly, a prosodic word contains one and only one lexical word and some adjacent grammatical morphemes. Our analysis, in effect, refines this definition by providing some specifics about mapping grammatical morphemes to prosodic words. All of the data we discuss will involve the retention or deletion of the object article "the" by a group of two-and-a-half year old children. Their pattern of "the" retention reveals three rates that are statistically different from each other. These are shown in (1a)-(1c).

(1)

Prosodic Structure for "the"	Child Forms	"the" Retained
(a) **footed, worded**		
he pushed the zebra [(ó σ)] [(ó σ)]	pushed the zebra	(78%)
he pushed the gi raffe [(ó σ)] [(ó)]	pushed the raffe	(72%)
(b) **unfooted, worded**		
he pushes the zebra [(ó σ)] [(ó σ)]	pushes zebra	(58%)
(c) **unfooted, unworded**		
he pushes the gi raffe [(ó σ)] [(ó)]	pushes giraffe pushes raffe	(28%)

Compare the first sentence in (1a) and the sentence in (1b). Notice that the retention rate of "the" in (1a) is 78%, while in (1b), "the" is retained only 58% of the time. Gerken concludes that "the" in (1a) is footed, while in (1b) it isn't. This is not a surprising conclusion, since the only possible foot that "the" could belong to in (1b) would be comprised of three syllables (mapped to "pushes the"), which is not a possible (or at least typical) foot structure in English. In keeping with Selkirk (1996), we assume that if "pushed" and "the" comprise a foot in (1a), then they are contained in the same prosodic word. In (1b), we show a prosodic structure in which "the" is not in the same prosodic word as "pushes." First, notice that in (1a) "pushed the zebra" and "pushed the giraffe," do not differ from each other statistically in the retention rate of "the." We argue that this is a direct consequence of "the" being footed and in the same prosodic word as the verb in both sentences.

The sentences in (1b) and (1c) begin with the same prosodic word headed by the lexical word "pushes." However, the retention rate of "the" in (1b) is nearly twice that in

(1c). This suggests that "the" in these 3 cases is mapped to different sorts of prosodic structures. The relatively low rate of retention in (1c) also leads to the conclusion that "the" must be in a more marked prosodic structure in that utterance. Therefore, in (1c) we represent "the" as neither contained in a foot nor in a prosodic word.

The observed difference between (1a) and (1b), namely that "the" in (1a) is footed while "the" in (1b) is not, will be handled by constraints on the right edges of prosodic words in the next section. The observed difference between (1b) and (1c), namely that "the" in (1b) is unfooted but worded, while "the" in (1c) is neither footed nor worded, will be handled by constraints on the left edges of prosodic words in a subsequent section.

The Right Edge of Prosodic Words

We begin our analysis with constraints on the right edges of prosodic words. The difference in retention rate leads us to the generalization that you see in (2).

(2) (1a) = (1b): If the lexical word that is the head of a prosodic word ends in a stressed syllable (1a), then a free grammatical morpheme immediately to it's right is included in the final foot of the word; if the lexical word ends in an unstressed syllable (1b), then a free grammatical morpheme to its right is not included in that foot or prosodic word.

The difference in retention rates of "the" in the "pushes the giraffe" and "pushes the zebra" utterances is only one reason we argue that children represent prosodic words. The other reason is that we only find the pushed/pushes contrast when the unstressed syllable following is a grammatical morpheme. When the unstressed syllable belongs to a lexical word, and thus must necessarily belong to a different prosodic word, the effect goes away. You see there is no statistically significant effect in (3a) and (3b), although this pair of sentences have virtually the same metrical structure as "pushed the zebra" and "pushes the zebra," where the effect is robust.

(3) Retention rates of the unstressed syllable "mi" (no statistically significant difference between (a) and (b)) and prosodic structures inferred:

(a) he pushed Mi chelle (42%)
[(σ́)] [σ (σ́)]

(b) he pushes Mi chelle (38%)
[(σ́ σ)] [σ (σ́)]

Below we introduce the constraints relevant to the right edges of prosodic words as well as some unviolated constraints that we will use in our analysis. The first group in (4) are unviolated constraints, and we will assume they are in force although they will not appear in our tableaux.

(4) Unviolated Constraints on Prosodic Structure (not shown in tableaux)

Max-ó I/O	All syllables stressed in the input must be stressed in the output.
Align-L (σ/ft)	(Align (ó, L, Ft, L) The left edge of all stressed syllables must align with the left edge of some foot.
PW {lw}	A Prosodic Word contains one (and no more than one) lexical word; every lexical word is contained in one Prosodic Word.
examples of violations:	*[Massa]$_{PW1}$[chusetts]$_{PW2}$ *[obvi]$_{PW}$ ous *[the]$_{PW}$

The first two constraints in (4) are not material to the difference between right and left edges, but are necessary to model the stress patterns in children's utterances. In this treatment, we make syllable formation and stress assignment as simple as possible, so that we can focus on the issue of prosodic word boundaries: We treat the input as though it were composed of a series of segments already in syllables. We assume that stress is in the input and that a highly ranked correspondence constraint forces all syllables that are stressed in the input to appear as stressed syllables in the output (**Max-ó I/O**). The constraint, **Align-L (σ/ft)**, has the effect that every stressed syllable must be footed and must be aligned with the left edge of the foot.

The constraint, **PW{lw}**, defines the composition of a prosodic word. Notice that this constraint means that every lexical word must be contained in a single prosodic word, and every prosodic word must contain a lexical word.

In (5) we formalize an observation we made when we reviewed the data, as well as some well-known constraints on prosodic structure.

(5) Violated Constraints on Prosodic Structure

Align R (PW)	(Align (Ft, R, PW, R) The right edge of every foot aligns with the right edge of a Prosodic Word.
FtBin	Feet are binary at the syllabic level.
Contig-σ	"Each syllable dominated by a prosodic foot F_x, must by contiguous with at least one other syllable parsed by F_x" (Alderete 1995).
σ/Ft	Every syllable must be contained within a foot. **(Parse-σ/Ft)**
σ/PW	Every syllable must be contained within a prosodic word. **(Parse-σ/PW)**

Align R (PW) is violated whenever the right edge of any foot does not align with the right edge of a prosodic word. It is an unviolated constraint in this data set, although it's clearly violated in the language at large if **PW{lw}** is an unviolated constraint. (For example, the leftmost foot of the word "massachusetts" would violate this constraint.) Our constraint, **FtBin**, states that feet must be composed of two syllables, and is violated in this data set when a syllable stressed in the input is not followed by an unstressed syllable within the same prosodic word. We include two parse-syllable constraints (**σ/Ft**, **σ/PW**). These are in the spirit of the principle of exhaustivity proposed by Selkirk (1996). The first parse constraint says that every syllable in the output must be contained within a foot. The second parse constraint says that every syllable must be contained within a prosodic word. These are relatively low-ranked constraints and are violated frequently, but forms that violate these constraints do not surface often in very young children.

The constraint, **Contig-σ**, forbids skipping syllables in the input when creating feet in the output. Thus it is a type of input-output correspondence constraint which only allows extrametrical syllables outside of feet. This formalization is taken directly from Alderete (1995). It is not violated in this data set.

Finally, in (6), we formalize a constraint on input-output faithfulness. **Faith I/O** is an input-output correspondence constraint on segmental material. It essentially says that all segmental material in the output must be in the input (no epenthesis). And all material in the input must be in the output (no deletions).

(6) Faithfulness Constraint (input-output)

Faith I/O All segmental material in the output must be in the input; all segmental material in the input must be in the output.

In the tableaux below, faithfulness violations will be counted by syllable.

In our first tableau, in figure (7), we treat the omission of "the" in the utterance, (1b) "he pushes the zebra". In the candidate set, we indicate the constituency of feet with parentheses, and stress is always on the leftmost syllable. Two constraints on the prosodic form of the output--a preference for representing binary feet, and a dispreference for unfooted syllables--are given priority over faithfulness in this grammar.

(7) Analysis of child form in (1b): "the" is unfooted and worded; attested output "pushes zebra"

/ púshes the zébra/	FtBin	σ/Ft	Faith I/O	Contig-σ
a. (pushes) (zebra) ☜			*	
b. (pushes) the (zebra)		*!		
c. (pushes the) (zebra)	*!			
d. (pushes) (the) (zebra)	*!			
e. (push the) (zebra)			*	*!
f. (push) (zebra)	*!		**	*

Crucial Rankings	(comparison candidate)	
FtBin >> FaithI/O	c,d	
σ/Ft >> Faith I/O	b	(adult-like candidate)

(ranking of **Contig-σ** is not determined)

The winner in the tableau, candidate (7a), does not violate **FtBin**, because both feet, "(pushes)" and "(zebra)", are two syllables long. There are no unfooted syllables in candidate (a), so it also doesn't violate Parse-Syllable. The candidate avoids these violations because "the" does not appear in the output. Thus, it incurs a violation of Faith I/O, but it's nevertheless the optimal candidate.

Candidate (7b) is the adult-like form. It incurs only one violation, **σ/Ft**,because "the" in the output is unfooted. So we know that **σ/Ft** must be higher ranked than **Faith I/O**; otherwise candidate (b) would be selected. Candidate (c) violates **FtBin** with the three-syllable foot "(pushes the)," and Candidate (d) violates **FtBin** with the one-syllable foot, "(the)." **FtBin** is the only constraint violated by these candidates, so we know that **FtBin** must be ranked above **Faith I/O**, or one of these candidates would be selected over candidate (a).

Candidate (e) is metrically identical to the winning candidate,(a), and, like (a), it violates **Faith I/O** once. But (e) violates the contiguity constraint, because the first foot maps on to the first and third syllable of the input, which are not a contiguous string. The contiguity constraint is operative, then, in this process, though it's unclear where it is ranked. For completeness, we include candidate (f), which is ruled out on several counts.

In the tableau shown in (8), we evaluate the same candidate set, but we rerank **Faith I/O** above the **σ/Ft**. Again, candidates (c), (d), and (f) are eliminated for **FtBin** violations. In the new ranking, candidates (a) and (e) lose because they violate input-output faithfulness. Candidate (b), the adult like candidate wins, despite a violation of **σ/Ft**, incurred for including the unfooted syllable "the." Thus, ranking input-output faithfulness with respect to **σ/Ft** is decisive in the competition between the adult-like and the child form.

(8) Analysis of adult-like form for (1b)

/ púshes the zébra/	**FtBin**	**Faith I/O**	**σ/Ft**	**Contig-σ**
a. (pushes) (zebra)		*!		
b. (pushes) the (zebra) ☜			*	
c. (pushes the) (zebra)	*!			
d. (pushes) (the) (zebra)	*!			*
e. (push the) (zebra)		*!		*
f. (push) (zebra)	*!	*!*		*

Crucial Rankings	(comparison candidate)
Faithfulness >> σ/ft	a (child form)
FtBin >> σ/Ft	c,d

Now let's consider how these rankings treat the utterance in (1a) "pushed the zebra." The most frequently attested child form is identical to the adult form in this case. In the tableaux in (9) and (10), we demonstrate that the rankings we have derived so far will select candidate (a), the attested winner. In fact, (a) doesn't violate any of the constraints in these tableaux, so any ranking will select (a). We might therefore predict that "the" retention rate among children in the case of this utterance would be 100%, which is not correct. Some possible accounts for the occasional omission of "the" in (1a) can be found in Gerken (1996).

(9) Analysis of child form in (1a); "the" is footed and worded; attested output (= adult form): "pushed the zebra"
σ/Ft >> Faith I/0

/ púshed the zébra/	**FtBin**	**σ/Ft**	**Faith I/O**	**Contig-σ**
a. (pushed the) (zebra) ☜				
b. (pushed) (zebra)	*!		*	*

(10) Analysis of adult-like form. Note: any reranking, selects the same candidate (10a).
Faith I/O >> σ/ft

/ púshed the zébra/	**FtBin**	**Faith I/O**	**σ/Ft**	**Contig-σ**
a. (pushed the) (zebra) ☜				
b. (pushed) (zebra)	*	*!		*

The utterance "pushed the giraffe," works in a similar way . In summary, the right edges of prosodic words have been determined by the right edges of feet.

The Left Edge of Prosodic Words

In this section, we turn to a treatment of the left edges of prosodic words. In figure (11), we summarize some generalizations we drew from the comparison between the retention rates of "the" in "pushes the zebra" and in "pushes the giraffe."

(11) (1b) ≠ (1c): If a grammatical word is not included in the right edge of a prosodic, then it is included inside the left edge of following prosodic word, but only if the lexical word head begins with a stressed syllable
[the (σ́ ...)].

The grammatical word is NOT included inside the left edge of a PW if the lexical word head begins with an unstressed syllable.
the [σ (σ́ ...)]

Only grammatical words that cannot be included inside the right edge of one prosodic word will ever surface inside the left edge of the following word. And then some metrical considerations to do with the lexical head of the second prosodic word come into play. If the lexical word begins with a stressed syllable, then the preceding grammatical word is included at the beginning of the prosodic word. If the lexical word begins with an unstressed syllable, then the preceding grammatical word is not included.

We codify this generalization in (12) in a constraint we call the "left-edge constraint." This constraint states that "the left edge of a prosodic word cannot abut a sequence of two unfooted syllables." In treatments of stress assignment in lexical words, this condition emerges from the ranking of **FtBin** above **Parse-Syllable** (see McCarthy & Prince 1993b), but, for a variety of reasons, in our model, an interaction of these constraints only has that effect on lexical words.

(12) *[σσ(... **Left-Edge** The left edge of a prosodic word cannot abut a sequence of two unfooted syllables.

The tableau in (13) shows the application of this new constraint. The addition of the new constraint does not permit the unique selection of the attested child form "pushes giraffe."

(13) Anaysis of child form in (1c); "the" should be unfooted and unworded.

/ púshes the giráffe/	Align-R (PW)	FtBin	*[σσ (...	σ/PW	Faith I/O	σ/ft
a. [(pushes)] [(raffe)]		*			*!*	
b. [(pushes)] [gi (raffe)] ☜		*			*	*
c. [(pushes)] the [gi (raffe)]		*		*!		**
d. [(pushes)] [the gi (raffe)]		*	*!			**
e. [(pushes)] [the raffe)] ☜		*			*	*

As expected, the adult-like candidate, (c) is ruled out by **σ/PW**. But note that the new ranking selects two candidates, (13b) which is an attested child output form, and (13e), which is never attested. The left edge constraint rules out candidate (d), in which the second prosodic word begins with the two unfooted syllables, "the" and "gi." But in the remaining candidates, one or both of these unfooted syllables fails to appear in the output, so no violation of the left-edge constraint occurs. To rule out candidate (e), all input syllables must somehow be represented in the output, even when segmental content isn't there.

One solution would be simply to extend the contiguity principle to syllables in prosodic words. Such a constraint is formalized in (14). It will rule out the offending candidate (e), because "the" is not contiguous with another syllable in the same prosodic word. This is illustrated in the tableau in (15).

(14) **Contig-σ** "Each syllable dominated by a prosodic word PW_x, must be contiguous with at least one other syllable parsed by PW_x" (following Alderete 1995).

(15) Analysis of child form in (1c): "the"is unfooted and unworded, and "gi" is unfooted; one attested form: "pushes giraffe"
***[σσ(... , σ/ PW >> Faith I/O >> σ/ft , Contig-PW.**

/ púshes the giráffe/	Align-R (PW)	FtBin	*[σσ(...	σ/PW	Faith I/O	σ/ft	Contig PW
a. [(pushes)] [(raffe)]		*			*!*		*
b. [(pushes)] [gi (raffe)] ☜		*			*	*	
c. [(pushes)] the [gi (raffe)]		*		*!		**	
d. [(pushes)] [the gi (raffe)]		*	*!			**	
e. [(pushes)] [the raffe)]		*			*	*	*!

The tableau in (16) shows the same set of candidates and constraints with **FaithI/O** demoted. This ranking selects candidate (a), the other attested child form.

(16) Analysis of child form in (1c): "the"is unfooted and unworded, and "gi" is unfooted; one attested form: "pushes raffe"

σ/PW , σ/ft , Contig-PW >> Faith I/O

/ púshes the giráffe/	Align-R (PW)	FtBin	*[σσ(...	σ/PW	σ/ft	Contig PW	Faith I/O
a. [(pushes)] [(raffe)] ☜		*				*	**
b. [(pushes)] [gi (raffe)]		*			*!		*
c. [(pushes)] the [gi (raffe)]		*		*!	**		
d. [(pushes)] [the gi (raffe)]		*	*!		**		
e. [(pushes)] [the raffe)]		*			*	*!	*

Finally, the tableaux in (17) shows that the adult form can be selected by moving **Faith I/O** above the two parse constraints.

(17) Analysis of adult-like form
Faith I/O >> σ/PW , σ/ft , Contig-PW

/ púshes the giráffe/	Align-R (PW)	FtBin	*[σσ(...	Faith I/O	σ/PW	σ/ft	Contig PW
a. [(pushes)] [(raffe)]		*		*!*			*
b. [(pushes)] [gi (raffe)]		*		*!		*	
c. [(pushes)] the [gi (raffe)] ☜		*			*!	**	
d. [(pushes)] [the gi (raffe)]		*	*!			**	
e. [(pushes)] [the raffe)]		*		*!		*	*

An alternative solution is to say that some of the syllables in the input appear in the output as zero syllables, which do not license segmental material. Only syllables containing segmental material are then visible to the parse constraints. We treat the ouput form, "pushes raffe" in (18). (In the tableaux below, zero syllables are indicated by sigmas with lines drawn through them.)

(18) Analysis of child form in (1c): "the" is unfooted and unworded, and "gi" is unfooted; one attested form: "pushes giraffe"

σ/ PW >> Faith I/O >> σ/ft

/ púshes the giráffe/	Align-R (Ft, Pw)	FtBin	*[σσ(...	σ/PW	Faith I/O	σ/ft
a. [(pushes)] σ [σ (raffe)]		*			**!	
b. [(pushes)] σ σ (raffe)]		*	*!		**	
c. [(pushes)] σ [gi (raffe)] ☜		*			*	*
d. [(pushes)] [σ gi (raffe)]		*	*!		*	*
e. [(pushes)] the [gi (raffe)]		*		*!		*
f. [(pushes)] [the gi (raffe)]		*	*!			**
g. [(pushes)] the [σ (raffe)]		*		*!	*	*
h. [(pushes)] [the σ (raffe)]		*	*!		*	*

Including zero syllables in the output increases the number of candidates we have to consider, but the Left-Edge Constraint rules out any candidates we don't want, (b), (d), (f) and (h). Of the remaining candidates, (a), an attested form, is ruled out here by **Faith I/O** , and (e) and (g) are ruled out because, although "the" is correctly analyzed as being outside of a prosodic word, since it surfaces with its segmental content intact, it violates σ/PW. Candidate (g), which was ruled out by contiguity in our first solution, is eliminated by the left-edge constraint here. This leaves the attested candidate (c) .

When we rerank Faithfulness below the parse-syllable constraints in the tableau in (19), the child form, "pushes raffe" is selected.

(19) Analysis of child form in (1c): "the" is unfooted and unworded, and "gi" is unfooted; the other attested form: "pushes raffe"

σ/PW , σ/ft >> Faith I/O

/ púshes the giráffe/	Align-R (Ft, Pw)	FtBin	*[σσ(...	σ/PW	σ/ft	Faith I/O
a. [(pushes)] σ [σ (raffe)] ☜		*				**!
b. [(pushes)] σ σ (raffe)]		*	*!			**
c. [(pushes)] σ [gi (raffe)]		*			*	*
d. [(pushes)] [σ gi (raffe)]		*	*!		*	*
e. [(pushes)] the [gi (raffe)]		*		*!	*	
f. [(pushes)] [the gi (raffe)]		*	*!		**	
g. [(pushes)] the [σ (raffe)]		*		*!	*	*
h. [(pushes)] [the σ (raffe)]		*	*!		*	*

And, finally, in (20), when we rank faith *above* the two parse constraints, the adult-like form is selected.

(20) Analysis of adult-like form
Faith I/O >> σ/PW , σ/ft

/ púshes the giráffe/	Align-R (Ft, Pw)	FtBin	*[σσ(...	Faith I/O	σ/PW	σ/ft
a. [(pushes)] σ [σ (raffe)]		*		**!		
b. [(pushes)] σ σ (raffe)]		*	*!	**		
c. [(pushes)] σ [gi (raffe)]		*		*		*
d. [(pushes)] [σ gi (raffe)]		*	*!	*		*
e. [(pushes)] the [gi (raffe)]		*			*!	*
f. [(pushes)] [the gi (raffe)]		*	*!			**
g. [(pushes)] the [σ (raffe)]		*		*	*!	*
h. [(pushes)] [the σ (raffe)]		*	*!	*		*

Conclusion

Let's compare the two analyses. Unlike some previous analyses of children's omissions, the two solutions presented here allow children to represent adult-like prosodic structure. In fact, it would be difficult to explain the pattern of omissions observed without recourse to this structure. Both analyses also can account for a variety of attested child forms through the ranking of input-output faithfulness and two parse-syllable constraints enforcing the nesting of syllables into larger prosodic structures. In particular, three rankings emerge that correspond to thee output types. These appear below in (21). When **Faith I/O** is ranked above the two parse constraints, the adult-like form is produced. When **Faith I/O** is interleaved between the parse constraints, only segments contained in prosodic words will surface. And when **Faith I/O** is ranked below the two parse constraints, only footed segments are in the output.

(21) 3 Output Types and the Ranking of **Faith I/O**

retain all segmental material	**Faith I/O >> σ/PW , σ/ft**
retain all segmental material in PWs	**σ/PW >> Faith I/0 >> σ/ft**
retain all segments in feet	**Faith I/O σ/PW , σ/ft >> Faith I/O**

There are several reasons we prefer the zero syllables analysis: First, the two parse constraints act as licensing constraints in the zero syllable analysis. That is, children represent all syllables that are in the input and correctly form large scale prosodic contituents. However, *segments* are licensed by a continuum of prosodic structures. Placing faithfulness in the continuum determines what types of prosodic structures--syllables, feet, prosodic words--will license segmental output.

Second--the segmental licensing notion is consistent with phonetic data. Carter (1996) found that the duration of children's utterances with omitted material was longer than metrically identical utterances from which nothing had been omitted. Thus, children appear to include zero-syllables in utterance timing.

Third, this analysis eliminates the need for the contiguity constraint. If we had included zero syllables in the analysis of right edges of prosodic words, we would not have needed a contiguity constraint in tableau (7); **FtBin** would have been sufficient.

Finally, an omission process that is systematic with respect to the grammar and yet quite volatile from moment to moment is treated here as involving little change in the grammar. Reranking faithfulness in an otherwise fixed and adult-like ranking of structural constraints is responsible for the variability. The prosodic structure remains constant even when the segmental content varies. This approach to variability in children's forms might usefully be extended to an examination of systematic variability in adult speech.

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Department of Linguistics
Douglass 200 E.
University of Arizona
Tucson, AZ 85721

amassar@u.arizona.edu
gerken@u.arizona.edu